Northern Territory Government

Mathematics Measurement

Mathematics

Measurement

Outcome

Key Growth Point 1

Learners use intentional communication strategies to interact with people, objects and activities.

Learners demonstrating solid evidence of

M KGP 1 Measurement

- actively seek and anticipate interactions with familiar people, activities, objects and environments
- use a limited repertoire of gestures, actions and vocalisation strategies to respond to a sensory cue actively

KGP 2

Learners differentiate the measurable attributes of an object. They use spatial language when visually comparing objects and indicate awareness of the order of routine events and stages of daily cycles.

Indicators

Key Growth Point 1 has three distinct developmental stages organised into six levels. The Key Growth Points Continuum on page two (2) describes the earlier stages of this development, whilst the indicators below provide the curriculum scope for planning and assessing learning within **Key Growth Point 1.**

Level 5 Anticipate

- choose from a limited range of responses to seek attention, request and respond to people, materials, objects, activities, eg show excitement or protest when presented with familiar objects, activities, environments; reach out toward a familiar object
- explore materials and objects, eg reach out to explore the position of objects
- seek objects that may not exist in immediate environment, eg actively look for or request objects
- participate in shared activities with intermittent prompts and cues, eg copy some actions during number rhymes, songs and number games
- sustain concentration for short periods of time
- observe the results of their own actions with interest, eg notice changes in visual or auditory input as a result of touching an object
- remember learnt responses over more extended periods, eg return to or request favourite number games
- make simple choices, eg use a yes/no system when presented with one option or reach for preferred object when presented with two objects

Mathematics Key Growth Points Learning Continuum

Awareness	Engagement	Participation
Level 1 Tolerate Learners allow themselves to be involved in an activity prompted by a familiar person. Learners are able to • produce simple reflex responses in response to the sensations they are experiencing, eg vocalisation, eye rolling, actions in response to feeling pain • produce simple reflex responses in response to external stimuli, eg startle reflex to a loud noise • rely on communication partner to prompt interaction	**Level 3 Respond** Learners change their body language in a more sustained and consistent way. Learners are able to • respond consistently to and show interest in familiar people, events and objects, eg point to known objects or people • react to new experiences, eg move towards an object, sound or movement source • accept and engage in co-active exploration of objects and environments, eg reach out and feel for objects as tactile cues to events	**Level 5 Anticipate** Learners use intentional communication strategies to interact with people, objects and activities. Learners are able to • choose from a limited range of responses to seek attention, request and respond to people, materials, objects, activities, eg show excitement or protest when presented with familiar objects, activities, environments; reach out toward a familiar object • explore materials and objects, eg reach out to explore the position of objects • seek objects that may not exist in immediate environment, eg actively look for or request objects • participate in shared activities with intermittent prompts and cues, eg copy some actions during number rhymes, songs and number games • sustain concentration for short periods of time • observe the results of their own actions with interest, eg notice changes in visual or auditory input as a result of touching an object • remember learnt responses over more extended periods, eg return to or request favourite number games • make simple choices, eg use a yes/no system when presented with one option or reach for preferred object when presented with two objects
Level 2 React Learners respond to a stimulus. Learners are able to • take part in interactions, activities and experiences through body language, actions, vocalisations, eg attend briefly to lights, sounds or patterns of movement • intermittently appear alert and focus attention on certain people, objects or parts of objects, and experiences, eg focus on sensory aspects of stories or rhymes when prompted • give unexpected or intermittent reactions within an interaction, activity or experience, eg become excited in the midst of social activity	**Level 4 Focus** Learners respond purposefully to a stimulus. Learners are able to • communicate consistent preferences and affective responses, eg reach out for favourite person • recognise familiar people, objects and experiences, eg recall an object that has been placed out of sight • perform actions by trial, error and improvement, eg hit a mathematical shape on a concept keyboard to make it appear	**Level 6 Choose** Learners request stimulus through gesture, action or vocalisation and are able to make a choice or express a preference. Learners are able to • request interactions and activities with consistent use of gesture, actions or vocalisations, eg prompt another person to join in an activity • use learned responses over increasing periods of time to engage in activities and anticipate future events, eg indicate an area of the yard to go to • respond to options presented with actions, gestures and/or vocalisations clearly expressing their preference • attempt to solve problems systematically, eg bring an object to an adult in order to request a new activity • choose to select or reject from a number of presented options within and outside experiences, eg choose to taste new foods

Mathematics

Measurement

Outcome

Key Growth Point 2

KGP 1
Learners use intentional communication strategies to interact with people, objects and activities.

Learners differentiate the measurable attributes of an object. They use spatial language when visually comparing objects and indicate awareness of the order of routine events and stages of daily cycles.

Learners demonstrating solid evidence of

M KGP 2.1 Physical attributes

- identify measurable attributes of an object
- visually compare the height, width or length of two objects without directly matching or aligning them and describe the comparison

M KGP 2.2 Time

- state that one event/stage comes before/after another

M KGP 2.3 Graduated scales

- identify graduated scales within familiar environment

KGP 3
Learners directly compare and order two or more objects or events with respect to a specified attribute. They demonstrate an emerging understanding of the relationship between quantity (as the number of units that fit) and measurement.

Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 2**

Knowledge and skills	Working mathematically
Physical attributes	**Physical attributes**
Length	**Length**
• visually identify the length of an object and state that it is long or short	• describe an object in terms of its length, in absolute terms, eg the pencil is tall/long and the crayon is short
• visually compare the length of two objects and state which is long and which is short but without (necessarily) lining up the bases	• describe two or three obvious attributes of the same object, eg the pencil is tall and thin
Area	**Area**
• visually identify an area or compare two areas and state which is large or small, eg state that a whiteboard is large	• describe the area of a surface in absolute terms, eg large/big or small
	• observe boundaries, eg when playing games
Volume	**Volume**
• stack and pack blocks into spaces	• select suitably sized objects to pack into a space and use everyday language such as ‘pack blocks into the box’
• visually identify an object or compare two objects and state which one is large or small, eg state that a cupboard is large or that a ball is small	• describe the volume of an object in absolute terms, eg large/big or small
Capacity	**Capacity**
• visually identify the capacity of an object (container) or compare the capacity of two objects and state which holds a lot or holds the most or the least	• describe capacity in absolute terms, eg full, empty, about half full
	• use language of capacity to communicate action, eg ‘pour more water into the bucket to fill it up’

Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 2 (cont)**

Knowledge and skills	Working mathematically
Mass	**Mass**
• physically test (heft) an object and describe its mass as being heavy or light, eg hard to lift or pull	• describe the mass of objects in absolute terms, heavy and light, eg make a chart showing objects that are heavy and light
• identify objects/materials that are heavy or light	
Time	**Time**
• state that one event/stage comes before or after another, eg we pack up before we go home	• use language of time to describe the order of events or daily cycle
• distinguish stages in daily cycle, eg today/ tomorrow, day/night	• ask questions to distinguish order of events or stages in daily cycle
Graduated scales	**Graduated scales**
• identify graduated scales within familiar environments, eg speedometer, bathroom scales, oven dial, thermometer	• respond to pictures of different familiar graduated scales and answer the question, 'Where might we find this?'
• identify attribute represented by familiar graduated scales, eg an oven dial and a thermometer are for temperature, bathroom scales are for weight	

Key Mathematical Language
Length: long, short, tall, thin, thick
Area: small, large, big
Volume/Capacity: large, small, pack, pour, stack, fill, holds, the most, the least, full, empty
Mass/Density: heavy, light
Time/Graduated Scales: before, after, first, last, recess, lunch, home-time, bedtime, wet season, dry season

Mathematics

Measurement

Outcome

Key Growth Point 3

KGP 2

Learners differentiate the measurable attributes of an object. They use spatial language when visually comparing objects and indicate awareness of the order of routine events and stages of daily cycles.

Learners directly compare and order two or more objects or events with respect to a specified attribute. They demonstrate an emerging understanding of the relationship between quantity and measurement.

Learners demonstrating solid evidence of

M KGP 3.1 Physical attributes

- order a series of objects in terms of the size of a specified attribute, using direct comparison
- count how many units of one object fit into another

M KGP 3.2 Time

- sequence routine events and days of the week and match events to days
- compare the duration of two or more events using informal units

M KGP 3.3 Graduated scales

- read the number closest to the 'mark' on a labelled, whole-number graduated scale

Band 1

Learners quantify attributes of objects and events by measuring with informal units. They ensure units are uniform and spatially aligned (no gaps or overlaps). They use the same units when comparing attributes and use formal units of length and read on the hour and half hour.

Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 3**

Knowledge and skills	Working mathematically
Physical attributes	**Physical attributes**
Length	**Length**
• identify the attribute of length as the end-to-end measure of an object	• report that an object is longer/taller than or shorter than another
• use comparative language for length, eg longer, higher, lower, taller than, shorter than, longest, shortest, in between, the same as, further, not as far	• select an object longer/shorter than another for a purpose and justify selection
• make direct comparisons of length, eg place two objects side by side and align the ends	• compare curved lengths by straightening and directly comparing, eg two pieces of string
• order two or more lengths by direct comparison	
• count how many units of an object (informal unit) will match the length of another object, but do not (necessarily) notice gaps or overlaps, eg how many popsticks fit along the desk?	
Area	**Area**
• identify the attribute of area as the amount of surface	• select a suitably sized paper/cloth to cover a surface, eg make a tablecloth from paper to cover a desktop

Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 3 (cont)**

Knowledge and skills	Working mathematically
Area (cont)	**Area (cont)**
• use descriptive language, eg inside/outside the shape, boundary, to communicate understanding of area as enclosed space	• use software, eg Paint, to explore the filling of simple shapes with colour and report findings
• cover regions or surfaces of objects with repeated small shapes and describe action	• overlay 'areas' to compare and use comparative language to describe, eg the yellow leaf is bigger than the green leaf
• make direct comparisons of area by superimposition	
• use comparative language to describe two areas, eg bigger than/smaller than, more than/less than	
• count how many repeats of an informal unit will cover an area but not (necessarily) notice gaps or overlaps, eg count how many potato prints fit in a square	
Volume	**Volume**
• identify attribute of volume of an object by the amount of space it occupies	• select a number of suitable units to fit within a space or to make a simple construction and count and report the number of units used
• visually compare the volume of two objects by observing which occupies the most space, eg recognise that the toy truck is bigger than the ball	• recognise and use objects that stack and pack well in various tasks
• use comparative language of volume to describe objects, eg more/less space, bigger/smaller, more/less blocks	• estimate and check which model/container uses/holds the most blocks
• make direct comparisons of volume, eg by stacking or packing materials from one model/container to another	
• count how many blocks (informal uniform units) make up the volume of an object, but not (necessarily) notice gaps between, eg how many multilink cubes fit in a box?	
Capacity	**Capacity**
• identify the attribute of capacity of a container as the amount (of material) the container can hold	• investigate the relative capacity of a variously shaped set of containers by pouring from one to another, eg a tall, narrow container and a short, wide container
• use everyday and comparative language of capacity to describe the space within containers and the actions that relate to the capacity attribute, eg pour, fill, nearly full, holds more/less than, full, empty, half full	• estimate which of a set of containers holds the most and check by pouring from one to another, keeping account of which holds more

Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 3 (cont)**

Knowledge and skills	Working mathematically
Capacity (cont)	**Capacity (cont)**
• make direct comparisons of capacity, eg by filling one container and pouring into another	• use comparative language to describe relative capacity of two containers, eg holds less/more, will hold more, will hold less
• order two or more containers by making direct comparison of capacities	
• count how many scoops or spoonfuls of materials (informal units), but not (necessarily) notice whether amounts of material are level scoops or spoonfuls, eg how many spoons of rice will fill a cup	
• describe the capacity of a container in terms of the number and type of units used, eg 5 scoops of rice	
Mass	**Mass**
• identify attribute of mass as equivalent to the heaviness of an object	• predict and check the action of a two arm balance for two objects after hefting
• use everyday and comparative language of mass and the actions that relate to the attribute of mass: heavier, lighter, too heavy, weigh, balance, equal-arm balance	• investigate the mass of a variety of objects including objects that are small, but heavy and objects that are large, but light
• make direct comparisons of mass, eg by hefting, lifting, pushing or pulling objects	• investigate how two pieces of plasticine can have the same mass, but look different, eg a piece rolled up into a ball, and a piece that has been flattened like a pancake (conservation of mass). Describe what is observed.
• compare the mass of two objects by direct comparison by placing objects in the pans of an equal-arm balance	
• explain that the heavier of two objects is on the lower pan of an equal-arm balance and that objects with the same mass balance	
• use an equal-arm balance with uniform informal units to describe the mass of an object, eg 5 marbles balance a cup	
Time	**Time**
• use descriptive language of time: week, morning, afternoon, night, today, yesterday, tomorrow, takes more/less time	• predict which of two events will be of longer duration and suggest a means of measuring, eg clapping
• sequence routine events of the day	• make/draw own model of a clock with numbers and hands
• name and sequence days of the week	• contrast alternate periods of a daily/weekly cycle by describing events that occur in, eg the day/ night, school/home, week-day/weekend
• recall that there are 7 days in a week	

Indicators

The curriculum scope for planning and assessing learning within **Key Growth Point 3 (cont)**

Knowledge and skills	Working mathematically
Time (cont)	**Time (cont)**
• compare the duration of two brief events using a rhythmic count, eg how many claps?	• match specific recurring events to the day of the week on which they occur
• compare durations of events using time sense alone, eg it takes longer to walk to the shop than to sharpen a pencil	• apply knowledge of the order of routine daily activities to construct a daily sequence chart, eg paste pictures to show sequence: waking up, eating lunch, cleaning teeth, going to bed
• understand that clocks are used to reflect the passage of time	• make a list of events that take a 'long time' and a list of events which take a 'short time'
• record the features of an analogue clock	
• identify other time measuring devices, eg sand timers, graduated candles, metronomes	
Graduated scales	**Graduated scales**
• read the number closest to the 'mark' on a labelled, whole-number graduated scale (may not necessarily align the zero of the scale with the baseline when measuring length for example)	• partition whole number sequences using number lines, eg fold a 0 - 10 number line in half and predict which number will be closest to the crease

Key Mathematical Language
Length: long, longer, longest, short, shorter, shortest, tall, taller, tallest, narrow, narrower, narrowest, wide, wider, widest, thick, thicker, thickest, thin, thinner, thinnest, further, farther, not as far, deep, high, low, in between, end, closer, closest, gaps, overlaps
Area: inside the shape, outside the shape, boundary, bigger than, more than, smaller than, less than, fits, does not fit
Volume/Capacity: holds less, holds more, nearly full, half full, half empty , larger, smaller, bigger, smallest, same as
Mass/Density: heavy, heavier, heaviest, too heavy, light, lighter, lightest, balance, equal-arm balance, hefting, lifting, pushing, pulling
Time/Graduated Scales: yesterday, today, tomorrow, next week, last week, morning, afternoon, night, school day, school, home, weekend, holiday, days of the week, longer than, less than, clock-face, hands, minute, hour

Mathematics

Measurement

Outcome

Band 1

KGP 3

Learners directly compare and order two or more objects or events with respect to a specified attribute. They demonstrate an emerging understanding of the relationship between quantity (as the number of units that fit) and measurement.

Learners quantify attributes of objects and events by measuring with informal units. They ensure units are uniform and spatially aligned (no gaps or overlaps). They use the same units when comparing attributes and use formal units of length. They read time on the hour and half hour.

Learners demonstrating solid evidence of

M 1.1 Physical attributes

- estimate and measure length, area, mass, capacity and volume using informal units
- estimate and measure length in metres or centimetres

M 1.2 Time

- estimate, measure and compare the duration of events using informal units
- read clocks to the hour and half hour and use calendars

M 1.3 Graduated scales

- associate the 'number of repetitions' of a unit with the numbers printed on a whole-number graduated scale and reliably read a linear scale to the nearest labelled graduation

Band 2

Learners estimate and measure attributes of objects and events using formal units. They describe the relationship between unit size and the number of units in a measure. They combine part units to estimate a total.

Indicators

The curriculum scope for planning and assessing learning within **Band 1**

Knowledge and skills	Working mathematically
Physical attributes **Length** • determine the length of an object by counting the number of repeated uniform informal units, positioned without gaps or overlaps, that fit along its length • describe length in terms of the number and type of units used, eg 5 popsticks long • compare lengths of objects or distances stating the number of units used to measure • use 'between' to describe length, eg is between 5 and 6 popsticks • explain that length remains constant when units are rearranged, eg when you measure left to right or right to left (conservation of length) • measure and record lengths as a number of metres, correct to the nearest metre; use the unit abbreviation m	**Physical attributes** **Length** • make and use a linear measuring tool using a repeated uniform informal unit and marking numbers of units • recognise that the same uniform unit must be used to compare the lengths of two objects • explain the relationship between unit size and the number of units used, eg paperclips are shorter than popsticks so more paperclips are needed to measure the desk • justify the use of uniform units with no gaps or overlaps when measuring length • select the appropriate formal unit for a measurement task and justify choice, eg suggest why the length of a desk might be best measured in cm rather than m

Indicators

The curriculum scope for planning and assessing learning within **Band 1 (cont)**

Knowledge and skills	Working mathematically
Length (cont)	**Length (cont)**
• measure and record lengths as a number of centimetres, correct to the nearest centimetre; use the unit abbreviation cm	• compare curved lengths, including circumferences, eg lids of tins and measure with informal units
• identify lengths that are approximately one metre	• describe estimation strategy, eg visualise an informal unit repeated along the length of an object
• estimate lengths/distances in m or cm	• use 'Draw' in Microsoft Word to construct horizontal and vertical lines of given lengths
Area	**Area**
• use comparative language to describe areas and to make area comparisons: small, smaller, smallest; large, larger, largest; no gaps or overlaps; about half a square tile, amount of space	• explain why squares are more appropriate than circles to measure area
• compare the area of two or more surfaces by covering with repeated uniform informal units and counting, leaving no gaps or overlaps	• make a tessellation using an array of suitable pattern blocks and explain the structure of the pattern in terms of rows and columns
• report area in terms of the number and type of units used, eg 6 tiles cover the book	• explain the relationship between unit size and the number of units used, eg you need more blue tiles than red tiles to cover the desktop because the blue tiles are smaller
• use a count of units to compare the area of surfaces which cannot be reasonably superimposed, eg the window is smaller because it has an area of 12 tiles while the door has an area of 24 tiles	• demonstrate that different shapes can have the same area using geoboards/electronic geoboards
• estimate the area of regions as a number of uniform informal units, check estimates	• describe estimation strategies, eg visualising repetition of square unit within a region
• use transparent 1 cm grid overlays to estimate the area of various shapes in 'squares'	• use 'Draw' in Microsoft Word to construct rectangles of various sizes, fill rectangles with colour and compare and order areas by eye and by superimposing one on another
Volume	**Volume**
• use everyday and comparative language of volume to describe models or packed spaces: pack, more/less blocks, layers, across, down, horizontal, vertical	• explain why cubes stack/pack better than marbles and many other objects
• construct models from cubes and state the volume as a number of cubes	• explain why one model has more volume than another by specifying the number of (identical) blocks needed to build each model
• describe volume in terms of the number and type of units used, eg 5 cubes	• devise and explain strategies for systematic packing and counting of blocks into the shape of rectangular prism
• compare the volumes of two of more models by building the models using identical informal units and counting the number of units required	• explain why variously shaped objects can have the same volume

Indicators

The curriculum scope for planning and assessing learning within **Band 1 (cont)**

Knowledge and skills	Working mathematically
Volume (cont)	**Volume (cont)**
• estimate and verify the volume of a box/space by packing (without gaps) using appropriate uniform units and counting units, eg use centicubes	• explain a strategy for estimating volume, eg visualising a unit repeated in space
• compare and order the volumes of two or more objects by marking the change to the water level when objects are submerged in a container of water	• explain the relationship between unit size and the number of units used, eg 'the blocks are bigger than the multilink so I won't need as many'
Capacity	**Capacity**
• compare the capacity of several containers by counting the uniform informal units needed to fill containers, eg number of level scoops, spoons or cups	• select the appropriate capacity unit for a measurement task and justify choice, eg use a cup rather than a spoon to fill an ice cream container
• estimate and verify capacity using appropriate uniform units	• explain the relationship between unit size and the number of units used to measure the capacity of a container, eg more spoons than cups are needed to fill an ice cream container
• calibrate a measuring jug in uniform informal units, and use the jug to measure the capacity of various containers	• explain how containers of different shapes can have the same capacity
	• recognise that a common uniform unit must be used to compare the capacities of two containers
Mass	**Mass**
• describe the mass of an object in terms of the number and type of units used, eg the toy has a mass of 6 cubes	• estimate the relative mass of two objects after hefting and check using equal-arm balance
• order the mass of two or more objects by making direct comparisons of mass using an equal-arm balance and keeping track of relative mass, has more/less mass	• select a suitable informal unit to measure the mass of an object, eg use marbles rather than blocks to find the mass of a toy car
• compare and order the mass of several objects using uniform informal units, eg the toy has a mass of 15 blocks and is heavier than the ruler which has a mass of 5 blocks, the pad and ruler have the same mass of 5 blocks	• explain the relationship between unit size and the number of units used to balance the mass of an object, eg more marbles will be needed than bolts because the bolts are heavier
	• explain that the mass of a lump of play-dough is independent of its shape
	• recognise that a common uniform unit must be used to compare the mass of two objects
Time	**Time**
• use language of time to describe calendar, times of day and clock times, eg year, month, week, day, o'clock, hour, half-hour, minutes	• estimate and check the time taken to perform a simple task, eg time to walk across the room while balancing a book on their head

Indicators

The curriculum scope for planning and assessing learning within **Band 1 (cont)**

Knowledge and skills	Working mathematically
Time (cont) • use informal units and timers to compare and order events, eg sand-timers, rhythmic clapping • use calendars to locate and record scheduled events and to write dates • name and order the months of the year, recall that there are 12 months in the year • approximately match local seasons to months of the year (including Indigenous seasons where appropriate) • read time on the hour and the half hour using both analogue and digital clocks • report and write times, eg six o'clock, half-past six, six thirty	**Time (cont)** • associate regular recurring classroom events to specific times on the clock at hour and half-hour • ask questions that indicate recognition of clock times, order of events and duration • match key events in the year to month in which these occur, eg birthday, Show Day
Graduated scales • read whole-number graduated scales to reliably measure to the nearest labelled graduation, eg use a ruler marked in cm to measure to the nearest cm	**Graduated scales** • fill in missing numbers on linear scales • determine the length of an object using a 'broken ruler' ie a scale which has the zero and first few units missing • determine approximate length, capacity or temperature by reading to the nearest labelled graduation of a linear scale

Key Mathematical Language
Length: length, estimate, metre, centimetre, unit, ruler, tape measure, trundle wheel
Area: no gaps or overlaps, same/different area, rows, columns, large/small
Volume/ Capacity: layers, rows, volume, capacity, raise/fall, greater/less than/same
Mass/Density: mass, greater/less than/same
Time/Graduated Scales: o'clock, half hour, year, month, week, day, calendar

Mathematics

Measurement

Outcome

Band 2

Band 1

Learners quantify attributes of objects and events by measuring with informal units. They ensure units are uniform and spatially aligned (no gaps or overlaps). They use the same units when comparing attributes and use formal units of length and read on the hour and half hour.

Learners estimate and measure attributes of objects and events using formal units. They describe the relationship between unit size and the number of units in a measure. They combine part units to estimate a total.

Learners demonstrating solid evidence of

M 2.1 Physical attributes

- estimate and measure attributes using concrete representations of the required formal units
- quantify the relationship between familiar units
- combine part units to estimate a total

M 2.2 Time

- read time from both analogue and digital clocks to the nearest minute
- read a variety of calendars, timetables and timelines
- measure duration of events

M 2.3 Graduated scales

- interpret unlabelled graduations on a linear scale where the graduations represent whole units

Band 3

Learners recognise that the accuracy of measurement can be improved by subdividing the unit used. They perform and interpret calculations using measurement data in order to solve problems.

Indicators

The curriculum scope for planning and assessing learning within **Band 2**

Knowledge and skills	Working mathematically
Physical attributes **Length** • measure length in millimetres; use the abbreviation mm • estimate lengths in mm • explain relationships between familiar formal units of length, ie 1 metre = 100 cm, 1 cm = 10mm and perform whole-number conversions between units, eg convert 2m to cm • measure lengths using metres and centimetres and record using the notation 2m 35cm or 2.35m • describe and measure the perimeter of shapes using formal units, eg perimeter of a quadrilateral = side 1 + side 2 + side 3 + side 4 • use a range of tools to measure lengths in formal units: ruler, tape measure, trundle wheel, depth gauge, metrilog, callipers	**Physical attributes** **Length** • explain the appropriateness of a selected informal or formal unit to measure length, eg why the length of an insect might be best measured in mm rather than cm • explain how the size of a unit used affects accuracy or measurement • measure the perimeter of a basketball court and explain why two people may obtain different measures for the same length • describe and justify an estimation strategy used • use drawing software, eg MS Word to construct rectangles of given dimensions and determine perimeters

Indicators

The curriculum scope for planning and assessing learning within **Band 2 (cont)**

Knowledge and skills	Working mathematically
Area	**Area**
• use language associated with measuring and calculating area: square centimetre, square metres, length, width, breadth, columns, rows, array, surface region	• devise a strategy for estimating an area if part squares and half squares are present when measuring using a cm^2 overlay grid or a geoboard
• measure, by counting square units and combining part units, eg When overlaying a grid on a shape look at partly filled squares and estimate how many full squares they would be equivalent to	• suggest where square metres are used in everyday situations, eg covering a floor with tiles or carpet
• compare areas in square metres using a physical representation of a square metre	• draw a plan for a handball court to specifications and construct the court in the playground, eg a court with four squares, each square being $4m^2$
• measure, by counting square units and combining part units, and compare areas in square centimetres using a visual representation such as a 1cm square overlay grid; include regular and irregular shapes	• use language associated with measuring area: square metre, square centimetre, length, width, breadth, columns, rows, array, surface
• record areas as a number of square metres or square centimetres	• determine the surface area of rectangular prisms by using a square cm overlay grid on each face and counting squares
• use the abbreviations m^2 and cm^2	• explain why an area of 1 square metre does not need to be in a square
• estimate areas in square metres or in square centimetres	• use efficient methods of counting square units in arrays, eg count units in one row and use skip counting to find the total
• identify areas that are less than, about the same as and larger than a square metre	•
• **Volume**	**Volume**
• measure and compare volumes of rectangular prisms (containers) in cubic centimetres, eg packing layers of centicubes in a box and counting the cubes in each layer	• describe a strategy for estimating capacity, eg visualising the amount in a cup
• report volume as a number of cubic centimetres; use the abbreviation cm^3	• explain the advantage of using a cubic unit when measuring volume
• estimate volumes in cubic centimetres	• recognise that the volume of an object does not reliably predict its mass, eg the ball is bigger than the block but is lighter
• use the technique of displacement to compare and order the volumes of two or more objects, eg measure in mL the change in water level or overflow when objects are submerged in a container of water	• investigate how many different models can be made by joining six centicubes in different ways
• construct a model of a cubic metre and use this to recognise volumes that are less than, about the same as and larger than a cubic metre	• relate the volume represented by the big block (Base 10 blocks) to a familiar 1 litre container, eg a litre of milk
Capacity	**Capacity**
• measure and compare capacity of large containers to the nearest litre, using a 1 litre measuring device	• design a litre measuring device calibrated in 100mL intervals

Indicators

The curriculum scope for planning and assessing learning within **Band 2 (cont)**

Knowledge and skills	Working mathematically
Capacity (cont)	**Capacity (cont)**
• report capacity as a number of litres; use the abbreviation L	• investigate and report the capacity of everyday containers used in kitchens, eg 1 teaspoon = 5mL, 1 cup = 250mL
• measure and compare capacities measured in millilitres, to within 10mL	• design differently shaped containers that have a capacity of one litre
• report capacity as a number of millilitres; use the abbreviation mL	• estimate, measure and record how many 100mL scoops are required to fill a one litre container
• recognise that there are 1 000mL in 1 litre	• estimate capacity of familiar commercial containers by visually comparing to a 1 litre container
• estimate and record capacities in litres and millilitres	
• convert between litres and millilitres, eg 1 200mL as 1 litre and 200 millilitres	
Mass	**Mass**
• measure and compare the mass of objects to the nearest kilogram using an equal-arm balance, eg compare objects that have a mass less than, more than and equal to a kilogram; use the abbreviation kg	• describe the relationship between the relative mass of different informal units and the number of those units needed to find the mass of an object, eg the book has a mass of 6 large blocks, or 12 small blocks because the large block is twice the mass of a small block
• report the mass of objects in kilograms and grams; use the abbreviation kg and g	• design an object that can be used on an equal-arm balance as a 1 kilogram mass
• measure and compare mass of objects in grams using an equal-arm balance and weighted centicubes, that have a mass of 1g each	• use interlocking centicubes, each having a 1g mass, to make a variety of objects that have the same mass, eg use 20 cubes to make different looking objects that have a mass of 20g
• explain that there are 1 000g in 1 kilogram	• locate and record the mass of contents shown on commercial packaging; verify by weighing
• recognise common fractional equivalents of a kilogram, eg ½ kg is 500g, ¼ kg is 250g	• measure mass of objects using a variety of devices including analogue kitchen scales, digital scales and spring balances
Time	**Time**
• measure and compare duration of two or more events in seconds, eg John ran a race in 25s, Joe in 27s, John took less time	• investigate the relationship between the hands of a clock and the equivalent digital time using interactive software
• record time in seconds; use unit abbreviations	• investigate the relationship between fractions and time by folding a 0 – 60 number line in halves and quarters, and then taping it to make a circle
• read time to the nearest minute using both analogue and digital clocks	• estimate and verify how many times a simple task can be performed in one minute, eg how many times can you write your name?

Indicators

The curriculum scope for planning and assessing learning within **Band 2 (cont)**

Knowledge and skills	Working mathematically
Time (cont) • report times as minutes past the hour in analogue and digital language, eg twenty five past six, six twenty five • use the terms 'quarter past' and 'quarter to' • record time from analogue or digital clocks using digital notation designating am or pm, eg 6:25pm • describe relationships between time units, ie 1 year = 52 weeks; 1 year = 365 days; 1 hour = 60 minutes • report durations as a number of hours and/or minutes; use unit abbreviation, h, min, eg 2h 20 min • convert between analogue and digital representations of time • estimate duration of familiar events in hours, minutes or seconds • read and interpret timetables and timelines in 12 hour notation	**Time (cont)** • solve problems using a calendar, eg What is the date of the third Wednesday in August? What is the date two weeks after this?
Graduated scales • read unlabelled graduations on a linear, whole number scale	**Graduated scales** • read a spring balance to the nearest gram or an analogue kitchen scale to the nearest 100g • read a ruler to the nearest millimetre • read a room thermometer to the nearest degree • identify the places where units correspond when a 0 – 12 number line is superimposed with a 0 – 60 number line, ie 1 and 5, 3 and 15, 6 and 30, 9 and 45 - fill in missing units on these number lines - use two pointers to mark time on these number lines (a linear clock) - explain why analogue clocks are generally circular

Indicators

The curriculum scope for planning and assessing learning within **Band 2 (cont)**

Key Mathematical Language
Length: millimetre, conversion, convert, perimeter
Area: square metres, square centimetres, length, width, breadth, surface, columns, rows, array
Volume/Capacity: cubic centimetre, cubic metre, volume, litre, millilitres, metric
Mass/Density: kilogram, grams, half a kilogram, quarter of a kilogram
Time/Graduated Scales: second, analogue, digital, timetable, am, pm, thermometer, degree

Mathematics

Measurement

Outcome

Band 3

Band 2

Learners estimate and measure attributes of objects and events using formal units.
They describe the releationship between unit size and the number of units in a measure. They combine part units to estimate a total.

Learners recognise that the accuracy of measurement can be improved by subdividing the unit used. They perform and interpret calculations using measurement data in order to solve problems.

Learners demonstrating solid evidence of

M 3.1 Physical attributes

- perform calculations on measurements in order to convert between units and to determine the area of triangles, rectangles and composite shapes and the volume of rectangular prisms.

M 3.2 Time

- convert between 12 hour and 24 hour representations of time
- calculate duration of time given a starting and finishing date and/or time in either 12 or 24 hour representations

M 3.3 Graduated scales

- interpret unlabelled graduations representing 1/10th of a unit on a linear scale

Band 4

Learners recognise that all measurement is approximate, stating ranges of accuracy for measurement data. They combine the attributes of familiar objects and events to determine useful ratios and use these to solve problems.

Indicators

The curriculum scope for planning and assessing learning within **Band 3**

Knowledge and skills	Working mathematically
Physical attributes **Length** • use calculations to find lengths (distances) that cannot be directly measured • recognise that longer lengths require a larger unit, ie the kilometre • use the abbreviation, km • record length in kilometres, using decimal notation to 3 places, eg 5.125km • measure and record lengths using a combination of formal units, or decimal notation, eg 5.125km or 5km and 125m; 3.25m or 3m and 25cm; 3.5cm or 3cm and 5mm • compare lengths by converting to a common unit, eg 1.2km and 843m becomes 1 200m and 843m	**Physical attributes** **Length** • estimate the length of objects taking into account the degree of accuracy required for a given situation or purpose, eg estimating the length of wood needed for a project • select appropriate measuring tool and unit for a practical task and justify selection • draw a map, showing distances travelled on an interstate trip, using a simple scale, eg 1cm = 100km • describe the relationship between length of sides and perimeter for squares, rectangles, equilateral and isosceles triangles • demonstrate, through a performance task, an understanding of the relationship between time, speed and distance, eg walk a given distance in a specified time

Indicators

The curriculum scope for planning and assessing learning within **Band 3 (cont)**

Knowledge and skills	Working mathematically
Length (cont)	**Length (cont)**
• identify and measure features of a circle: circumference, diameter and radius	• explore and predict relationship between the diameter and circumference of a circle
• informally describe the relationship between the length of the circumference and diameter	• solve measurement problems involving mixed units, eg find the total of 3.5m and 25cm
Area	**Area**
• develop and use relationships between familiar formal units of area; 1 square metre = 10 000 square cm, 1 square cm = 100 square mm	• use efficient strategy for counting part squares, such as discard areas less than half a square and count as 1 square areas greater than half a square
• develop and use the formula for finding the area of a rectangle; describe the relationship between length, width and area	• solve problems involving relationships between length, perimeter and area, eg what are some possible dimensions of a rectangle which has an area of 24cm^2? What are the areas of rectangles that have a perimeter of 24cm? Which rectangle has the largest area given a perimeter of 24cm?
• develop and use the formula for finding the area of a triangle; describe the relationship between base, perpendicular height and area	• explore geometrically the relationship between the areas of rectangles and triangles with the same dimensions, ie same base and height
• calculate the surface area of rectangular prisms by determining and adding the areas of the faces	• devise a method to calculate the approximate area of a large region, eg the school library
• recognise the need for a larger unit of area, hectare and square kilometre	• using a learner as a unit of area, calculate how many learners could stand shoulder to shoulder in a classroom, in one hectare, in one square kilometre
• record, compare and order measurements of large areas in square km and hectares, eg the areas in hectares of rural blocks, the areas in square kilometres of Australian states and territories	
• record area measurements using the abbreviations ha and km²	
• explain and use the relationship between hectares and square metres; 1 hectare = 10 000 square metres (100m x 100m)	
Volume	**Volume**
• estimate volumes in cubic metres	• explore the relationship between mL and cm³ by displacing water in graduated containers with metric cubes, ie show that a cube with sides of 1cm will displace 1mL and a cube with sides 10cm will displace a litre
• record volume as a number of cubic metres and use the abbreviation m³	• use the technique of displacement to determine the volume of irregular objects, eg equate the displacement in mL with the volume of the object in cm^3
• estimate and calculate the volume of a large space, eg the general purpose room is 500m³	
• record volume using decimal notation to three decimal places, eg 3.125m³	

Indicators

The curriculum scope for planning and assessing learning within **Band 3 (cont)**

Knowledge and skills	Working mathematically
Volume (cont)	**Volume (cont)**
• find the volume of a rectangular prism given the linear dimensions (length, width and height)	• design a rectangular prism for a purpose given a specified brief, eg design a box for a pizza that is 30cm in diameter and 2cm high
• recall and apply the relationships between volume and capacity and convert between units in order to perform comparisons or calculations: $1cm^3 = 1mL$; $1\,000cm^3 = 1L$; $1\,000L = 1m^3$	• develop the dimensions of all possible rectangular prisms built from a given number of cubes, eg 36 cubes
	• demonstrate that the volume of a rectangular prism can be calculated by finding the number of cubes in a layer, then multiplying by the number of layers
Capacity	**Capacity**
• recognise that larger containers, eg swimming pools, need a larger unit of capacity, the kilolitre	• measure small amounts of liquid when conducting science experiments
• record capacity in kilolitres from examples and problems; use abbreviation kL	• design and test containers that will hold small amounts of liquid, eg 10mL, 25mL, 75mL
• record capacity using decimal notation to 3 places, eg 3.345L	• select appropriate measuring devices to measure capacity in practical tasks
• recall the relationships between units of capacity, such as 1 000mL = 1L; 1 000L = 1 kL	• solve measurement problems involving mixed units, eg find the total of 3.5L and 25mL
• convert between units of capacity, eg 1.2kL = 1 200L, 3 525 mL = 3.525L	• estimate and calculate the capacity of very large containers in kilolitres, eg a cargo container
• measure capacity using appropriate devices calibrated in millilitres, eg 9 mL from a medicine glass, 5 mL from a syringe, 125mL from a graduated container	
Mass	**Mass**
• recognise that larger masses need a larger unit of mass, the tonne	• suggest objects with mass estimated to be less than, more than and about one tonne
• record mass in tonnes from examples and in problems; use the abbreviation t	• measure quantities in order to follow recipes, eg quantities used in making a pizza
• describe the relationship between units of measurement, ie 1 000 kg = 1 tonne	• measure quantities in conducting science experiments, eg 5g of salt to 20mL of water
• record mass using decimal notation to 3 places, eg 3.345t	• investigate how many ice cubes would be required to make a 1 tonne mass of ice

Indicators

The curriculum scope for planning and assessing learning within **Band 3 (cont)**

Knowledge and skills	Working mathematically
Mass (cont)	**Mass (cont)**
• relate mass and capacity measures of water, such as 1L = 1kg 1kL = 1 tonne	• select suitable measuring instruments and units to measure different objects or materials representing a wide range of masses • solve measurement problems involving mixed mass units, eg find the total of 3.5kg and 25g • solve measurement problems involving calculating the mass of one item from a collection of known mass, eg what is the mass of one sheet of A4 paper from a ream (500 sheets) with mass 3kg?
Time	**Time**
• convert between 12 and 24 hour representations of time • convert between hours, minutes and seconds, eg how long is 98 minutes in hours and minutes? • convert between years, days and weeks in problem settings • read and interpret 12 and 24 hour timetables from real contexts • calculate elapsed time given start and finish times • informally investigate the relationship between distance, time and speed	• determine the duration of a DVD movie in hours and minutes given the information on the cover • read and interpret a range of timetables in 12 and 24h time, eg plane, train or bus timetables • walk at a pace so that a given distance is covered in a given amount of time • solve time problems when recorded in different units, eg calculate total time worked for shifts of 4 hours, 3h 20min and 3h 45min • solve problems involving calculating elapsed time between events on a timetable
Graduated scales	**Graduated scales**
• interpret unlabelled graduations representing 1/10ths of a unit or 10 units on a linear scale, including both positive and negative readings	• locate a given decimal fraction on a ruler marked in cm and 1/10ths of cm, eg locate 3.6cm on this scale • use a small measuring cylinder to measure volume to the nearest mL • measure the mass of objects using analogue kitchen scales to the nearest 10g

Key Mathematical Language
Length: kilometre, circumference, diameter, radius
Area: formula, base, perpendicular height, dimension, surface area, hectare, square kilometre
Volume/Capacity: length, width, height, kilolitre
Mass/Density: tonne
Time/Graduated Scales: 12 hour, 24 hour, elapsed time, duration, speed, time, distance, graduation, graduated scale, internal, decade, century, fortnight

Mathematics

Measurement

Outcome

Band 4

Band 3

Learners recognise that the accuracy of measurement can be improved by subdividing the unit used. They perform and interpret calculations using measurement data in order to solve problems.

Learners recognise that all measurement is approximate, stating ranges of accuracy for measurement data. They combine the attributes of familiar objects and events to determine useful ratios and use these to solve problems.

Learners demonstrating solid evidence of

M 4.1 Physical attributes

- investigate spatially developed ratios, including pi, through measurement and calculation
- estimate, measure and calculate the volume and surface area of right prisms and cylinders and the area of circles, triangles, quadrilaterals and composite shapes

M 4.2 Time

- perform operations on units of time
- estimate and calculate rates, including speed, from their components

M 4.3 Graduated scales

- state the accuracy of measurements
- interpret unlabelled graduations representing non-decimal fractions or multiples of a unit on a linear scale

Band 5

Learners quantify the accuracy of measurement and measurement calculations through the use of significant figures. They apply Base 10 understanding to combine scientific notation with metric prefixes in specifying very large or small quantities and manipulate derived relationships to solve problems.

Indicators

The curriculum scope for planning and assessing learning within **Band 4**

Knowledge and skills	Working mathematically
Physical attributes **Length** • calculate the length of the circumference of a circle given the diameter or radius, by using an approximation of pi • find the radius or diameter of a circle given the circumference or area • determine the perimeter of quadrilaterals and composite figures • find the dimensions of a square given its perimeter, and a rectangle given the perimeter and one side length • develop and use formulae for finding the perimeter of triangles, rectangles and quadrilaterals • find the perimeter of quadrants of circles and semi-circles	**Physical attributes** **Length** • develop an approximate value for pi by measuring the circumference and diameter of a number of different circles • compare the perimeter of a polygon, eg hexagon inscribed in a circle, with the circle's circumference • develop a spreadsheet that is able to convert units of measurement for length • estimate lengths and distances visually and verify by measuring, using appropriate instruments and metric units, eg estimate the distance from one landmark to another and verify accuracy of estimate using Google Earth (http://earth.google.com)

Indicators

The curriculum scope for planning and assessing learning within **Band 4 (cont)**

Knowledge and skills	Working mathematically
	Length (cont) • devise and apply methods for accurately measuring objects that are too big or small for the available equipment, eg the thickness of a sheet of paper
Area • develop the formula for finding the area of a circle and use to solve related problems, eg find the area of quadrants and semi-circles; determine the radius, diameter and circumference of a circle given the area • develop the formulae for finding the areas of quadrilaterals including parallelograms, rhombi, kites and trapezia and use to solve related problems • adapt known formulae to find the area of composite shapes, to solve shaded area problems and to determine the surface areas of right prisms and cylinders • recognise that the relationship between the area and perimeter of shapes varies with their 'compactness' • measure and record area using hectares (ha) • calculate large areas in ha and km^2 • recall and apply the relationships below to convert between units in order to perform comparisons or calculations $1cm^2 = 100mm^2$ $1m^2 = 1\,000\,000\ mm^2$ $1ha = 10\,000m^2$ $1km^2 = 1\,000\,000m^2 = 100ha$	**Area** • design a park that occupies a total area of 1ha; use a scale drawing where 1 square cm = 25 square metres • investigate and report back on instances where the area of a shape has the same magnitude as its perimeter, eg a square with side length 4 has both an area and perimeter of 16 units; examine triangles, rectangles and circles • use Google Earth, to calculate the area, footprint, of landmarks, eg Giza Pyramids, Pine Gap radomes, roundabouts, Eiffel Tower • find the maximum areas of shapes given constraints, eg the maximum rectangular area that can be enclosed with 250m of fencing, if one boundary is a straight river, ie no fence needed • develop the formula for finding the area of a parallelogram by practical means, eg form a rectangle using cut and fold techniques • investigate the relationship between the perimeter and area of shapes • use Google Earth to take measurements of large areas of interest and calculate the area in ha or km^2 • develop a spreadsheet that is able to convert units of measurement for area
Volume • recognise that very large volumes, eg oceans, air space, require larger units of measurement, ie km^3 • develop the formulae for finding the volumes of right prisms and cylinders and use to solve related problems	**Volume** • explore the range of volumes of an open box that can be created from a single sheet of A4 paper; develop a generalisation to identify the maximum volume that can be obtained

Indicators

The curriculum scope for planning and assessing learning within **Band 4 (cont)**

Knowledge and skills	Working mathematically
Volume (cont)	**Volume (cont)**
• adapt known formulae to find the volume of part and composite objects, eg objects composed of half-cylinders	• investigate and report back on situations where the surface area of an object has the same magnitude as its volume; examine prisms and cylinders
• recognise that the relationship between the surface area and volume of objects varies with their 'compactness'	• use Google Earth to calculate the volume of landmarks, eg water towers
• recall and apply the relationships below and convert between units in order to perform comparisons or calculations $1cm^3 = 1\,000mm^3$ $1\ m^3 = 1\,000\,000cm^3$ $1km^3 = 1\,000\,000\,000m^3$	• develop a spreadsheet that is able to give the volume of a cylinder when provided with its linear dimensions
Capacity	**Capacity**
• recognise that very large capacities, eg dams and lakes, need a larger unit of measurement, ie megalitres	• perform calculations on large capacities in real-life contexts, eg estimate personal water consumption over 1 week and so calculate how much domestic water a large population would consume in 1 year
• estimate and calculate the capacities of containers which approximate cylinders, prisms and composites of these objects	• specify liquid quantities required so that a given ratio will result in a given volume, eg how much concentrate is required if 1 part concentrate to 5 parts water is to make 1 litre of cordial?
• recall and apply the following relationships and convert between units in order to perform comparisons or calculations 1 Megalitre (ML) = $1\,000m^3$ = 1 000 000L	• estimate and calculate the capacity of swimming pools
Mass	**Mass**
• differentiate between mass and weight and explain contexts in which variation occurs	• calculate your weight on different planets and the moon
• measure and record weight in Newtons, using the abbreviation N	• investigate the relationship between mass and volume, eg using a graduated container determine the mass of different amounts of a given liquid. Compare these results with those obtained using a different liquid, eg compare aqueous and non-aqueous liquids such as water and spirits or water and oil.
• record mass in milligrams from examples and problems using the abbreviation mg	
• convert between Newtons and kilograms, ie equate weight with mass for Earth's gravity; 1kg ≡ 9.8N	
• recall and apply the following relationship and convert between units in order to perform comparisons or calculations 1g = 1 000 mg; 1kg = 1 000 000 mg	

Indicators

The curriculum scope for planning and assessing learning within **Band 4 (cont)**

Knowledge and skills	Working mathematically
Time	**Time**
Time keeping	**Time keeping**
• mentally determine time intervals to the nearest minute given starting and finishing times	• perform calculations to make predictions involving rates, eg if someone walks 50m in 37.4s, how long would it take to walk 1 km in minutes and seconds?
• perform operations on time units using a calculator, ie using degrees, minutes, seconds keys, and interpret calculator displays to the nearest minute or hour	• develop travel plans using a range of timetables, locations and time zones
• convert between decimal fractions of time units and hours, minutes and seconds, eg represent 0.125 of a day in hours, minutes and seconds.	• determine the optimum time for a teleconference between people in different time zones. Use web-based meeting planners to assist, eg http://www.worldtimeserver.com/meeting-planner.aspx
• perform calculations on time units involving International Time Zones, eg calculate time intervals where start and finish times are given as local times in different zones	• convert reaction times into milliseconds
• recognise that smaller intervals of time can be more clearly expressed using smaller units, ie milliseconds	
• use the abbreviation ms	
• recall and apply the following relationships and convert between units in order to perform comparisons or calculations; 1 000ms = 1s	
Rates	**Rates**
• recall and explain the formula for speed and use to solve related problems	• calculate speed from measurements taken in a variety of practical situations, eg trolley cars, balloon rockets, passing vehicles
• record speed using the abbreviations m/s or km/hr	• use technology to collect data for speed/velocity and acceleration analysis, eg ticker tape timers, data loggers and video analysis software - Logger Pro
• recall and apply relationships and convert between units in order to perform comparisons or calculations, 1m/s = 3.6km/hr	• perform practical investigations involving flow rates, eg determine how much water a leaky tap will waste over a year
• perform calculations to make predictions involving flow rates, eg if a tap has a given flow rate, determine how long it will take to fill containers of different capacities	
Graduated scales	**Graduated scales**
• interpret unlabelled graduations representing non-decimal fractions or multiples of a unit, on a linear scale	• read a scale to the most appropriate subunit based on the purpose of measurement, ie a short length of fabric may be measured to the nearest cm whereas a beam for a building needs to be measured to the nearest mm
• estimate values that lie between marked graduations on scales of measuring instruments	• explain why it is more correct to record measurement as an interval rather than as a point

Indicators

The curriculum scope for planning and assessing learning within **Band 4 (cont)**

Knowledge and skills	Working mathematically
Graduated scales (cont) • state the accuracy of recorded measurements as a range where the upper and lower limits are half of the smallest unit represented on the scale, ie ± 0.5 units • identify sources of error arising from repetition of rounding when calculating	**Graduated scales (cont)** • make judgements about acceptable or reasonable error in a measurement context, eg what is an acceptable error in terms of mass for a 1 tonne load of sand compared with a dosage of medicine?

Key Mathematical Language

Length: cubit, span, hand, nautical mile, pi

Area: quadrant, sector

Volume/Capacity: cubic kilometre, magnitude, megalitre

Mass/Density: Newton, milligram, gravity, density

Time/Graduated Scales: milliseconds, Time Zone, AEST, ACST, AWST, GMT, daylight saving, velocity, acceleration, flow rate, kilowatt

Mathematics

Measurement

Outcome

Band 5

Band 4

Learners recognise that all measurement is approximate, stating ranges of accuracy for measurement data. They combine the attributes of familiar objects and events to determine useful ratios and use these to solve problems.

Learners quantify the accuracy of measurement and measurement calculations through the use of significant figures. They apply Base 10 understanding to combine scientific notation with metric prefixes in specifying very large or small quantities and manipulate derived relationships to solve problems.

Learners demonstrating solid evidence of

M 5.1 Physical attributes

- perform calculations involving derived relationships, algebraically ensuring correct units for the answer
- estimate, measure and calculate the volume and surface area of spheres, right cones, right pyramids and associated partial and composite solids

M 5.2 Time

- perform calculations which include the use of pre-calculus concepts to solve problems involving rates of change

M 5.3 Graduated scales

- convert between digital notation, scientific notation and unfamiliar metric prefixes
- specify the accuracy of a measure through the use of significant figures
- perform calculations involving numbers expressed in scientific notation, preserving significance
- interpret unlabelled graduations on a logarithmic scale

Band 5+

Learners develop models to describe general forms of unfamiliar relationships between attributes. They explore and represent rates of change through the use of calculus and the flexible application of exponential scales. They perform calculations involving both scalar and vector quantities.

Indicators

The curriculum scope for planning and assessing learning within **Band 5**

Knowledge and skills	Working mathematically
Physical attributes **Length** • perform calculations involving extreme lengths (very large or very small), expressing answers in scientific notation where appropriate, eg if a bacillus bacteria is 1.50 μm long, how many would fit end to end across a 10cm diameter Petri dish?	**Physical attributes** **Length** • investigate the definitions, equivalents and uses of extreme units, eg How is a light year defined? What is its metric equivalent? How does it compare with a parsec or an Astronomical Unit? • solve length problems requiring the development of generalisations for unfamiliar relationships, eg - find a solution for calculating the length of ribbon/string to tie up a cuboid parcel of dimensions x, y and z cm. Apply the solution to create a 'ribbon length ready reckoner' using a spreadsheet or graphical calculator. - use a long strip of paper to create a 'tree diameter ready reckoner' to use around a tree's circumference - if a steel cable was wrapped around the Earth's equator, determine how much longer it would have to be for everyone to be able to walk under it

Indicators

The curriculum scope for planning and assessing learning within **Band 5 (cont)**

Knowledge and skills	Working mathematically
Area	**Area**
• develop the formulae for finding the surface area of right prisms, cones, spheres and pyramids and use to solve related problems, eg find the surface area of partial and composite shapes	• investigate and generalise the relationship between scale factor and surface area for regular shapes, eg if a given square based pyramid is doubled in size, how will the surface area change? Create a general rule to determine the surface area for any scale factor. • use information from Google Earth (http://earth.google.com) to calculate the surface area of large regular structures, eg determine the surface area of the dome of Hagia Sophia by measuring its perimeter and by assuming that it is hemispherical. Calculate the number of mosaic tiles required to cover the inside surface if the average tile size is 24cm^2.
Volume	**Volume**
• develop the formulae for finding the volume of right prisms, spheres, cones and pyramids and use to solve related problems, eg find the volume of partial and composite shapes	• investigate and generalise the relationship between surface area and volume for regular shapes, ie modelled with simple cases using cubes • use information from Google Earth to calculate the volume of landmarks, eg Giza Pyramids, Pine Gap radomes • compare the formulae for volume of cones to that of cylinders and suggest reasons for the similarities and differences • investigate and report back on situations where the surface area of an object has the same magnitude as its volume; examine spheres and cones • develop a spreadsheet that is able to give the volume of a sphere when provided with its radius
Time	**Time**
Rates	**Rates**
• explain the formula for acceleration and use to solve related problems • record acceleration using the abbreviation m/s^2 • determine acceleration from a graph or table showing a series of average speeds for a vehicle over an iterated time interval, eg 1 second periods	• calculate acceleration from measurements taken using ticker-timers or video coupled with data gathering software, eg Logger Pro, in a variety of practical situations, eg trolley cars rolling down an inclined plane, falling objects

Indicators

The curriculum scope for planning and assessing learning within **Band 5 (cont)**

Knowledge and skills	Working mathematically
Graduated scales • interpret labelled graduations on a Base 10 logarithmic scale • convert between digital notation, scientific notation and unfamiliar metric prefixes, eg 1 light-year = 9 460 730 472 580 800m ≈ 9.46 x 1 015m = 9.46 petametres (Pm) • perform calculations using quantities expressed in scientific notation • specify the accuracy of a measured quantity through the use of significant figures, eg if an object measures 5cm long to the nearest mm, then it is expressed as 5.0cm • perform calculations involving numbers expressed in scientific notation, with attention to the number of significant figures of the answer, ie when multiplying or dividing, an answer has the same number of significant figures as the number in the least precise measurement used in the calculation, and when adding or subtracting, the answer must have the same number of decimal places as the least precise measurement used	**Graduated scales** • interpret instrument readouts which use a logarithmic scale, eg a spectrophotometer • apply knowledge of significant figures when reporting measurements made in practical activities, eg science experiments • solve problems where quantities are very large or very small and are expressed in scientific notation, eg given the cruising speed of the Galileo Jupiter probe once it left Earth's orbit in m/s and the distance from the Earth to the Jupiter probe in km, calculate the travel time to the nearest significant time period

Key Mathematical Language
Time/Graduated Scales: light year, parsec, Astronomical unit, logarithmic

Mathematics

Measurement

Outcome

Band 5+

Band 5

Learners quantify the accuracy of measurement and measurement calculations through the use of significant figures. They apply Base 10 understanding to combine scientific notation with metric prefixes in specifying very large or small quantities and manipulate derived relationships to solve problems.

Learners develop models to describe general forms of unfamiliar relationships between attributes. They explore and represent rates of change through the use of calculus and the flexible application of exponential scales. They perform calculations involving both scalar and vector quantities.

Learners demonstrating solid evidence by

M 5+.1 Physical attributes

- derive formulae to describe the general form of unfamiliar relationships between attributes of shapes and objects
- estimate, measure and calculate the volume of oblique cones, cylinders, prisms and pyramids and the surface area of oblique cylinders, prisms and pyramids
- distinguish between scalar and vector quantities and perform calculations involving vectors

M 5+.2 Time

- solve problems involving related rates of change which require introductory calculus

M 5+.3 Graduated scales

- interpret unlabelled graduations on exponential scales including Base 10 and natural logs, scientific notation, preserving significance
- interpret unlabelled graduations on a logarithmic scale

Indicators

The curriculum scope for planning and assessing learning within **Band 5+**

Knowledge and skills	Working mathematically
Physical attributes **Area** • develop the formulae for finding the surface area of oblique prisms and oblique cylinders and use to solve related problems, eg find the surface area of partial and composite combinations of these shapes • develop generalisations of the relationships between various attributes of a shape or object • develop and use formulae for finding the area of a triangle to solve problems where the height of the triangle is unknown, eg use Heron's formula and A = ½ a b SinC	**Physical attributes** **Area** • use relationships between area and perimeter or radius and surface area to solve problems and generalise solutions, eg - find several sets of linear dimensions for a rectangular prism having a total surface area of 72cm^2 - use a spreadsheet or graphical calculator to generate several sets of linear dimensions for a rectangular prism of any given total surface area, ie a user inputs any positive number for the surface area and the program returns the solutions - using a balloon, explore the relationship between number of breaths and the surface area. Develop a mathematical model, and use on a spreadsheet and/or graphical calculator. - create a spreadsheet that calculates the surface area for objects including oblique cylinders and specific oblique prisms

Indicators

The curriculum scope for planning and assessing learning within **Band 5+ (cont)**

Knowledge and skills	Working mathematically
Volume • develop the formulae for finding the volume of oblique prisms, oblique cones and oblique pyramids and use to solve related problems, eg find the volume of partial and composite combinations of these shapes • develop generalisations for the relationships between linear attributes, surface area and volume for a range of shapes	**Volume** • use relationships between area and perimeter or radius and surface area to solve problems and generalise solutions, eg - create a spreadsheet that calculates the volume for oblique cylinders and specific oblique prisms, ie will automatically calculate the vertical height based on the side length and angle of skew and include this in the calculation - using a balloon, explore the relationship between number of breaths and the volume. Develop a mathematical model, and use on a spreadsheet and/or graphical calculator. - investigate which is the better fit; a cube enclosed in a sphere, or a sphere enclosed in a cube
Scalars and vectors • recall the difference between scalar and vector quantities, eg distinguish between distance and displacement, speed and velocity • calculate the magnitude and direction of a vector resulting from the sum or difference of two vectors and represent on a Cartesian plane • calculate the magnitude and direction of the product of a scalar and a vector quantity • develop and apply the formula for determining the scalar product (dot product) of two vectors	**Scalars and vectors** • solve problems requiring the manipulation of vector quantities, eg - a scuba diver swims 25m/min along a bearing of 170 degrees. The water is moving with a current of 10m/min along a bearing of 115 degrees. Find the diver's resultant velocity (speed and bearing) by adding these two velocity vectors.
Time **Rates** • develop and apply a formula to determine related rates of change involving measurement based formulae	**Time** **Rates** • solve problems by applying calculus to spatial formula for regular shapes and objects, eg - a stone dropped into a still pond sends out a circular ripple whose radius increases at a constant rate of 1 m/s. How fast is the area enclosed by the ripple increasing when the radius of the ripple is 3 metres? - SN1993J is a supernova, an exploding star in the form of a sphere. The radius of SN1993J expands at a constant rate of 14900 ±200 km/s. How fast would the volume occupied by the supernova be expanding one year after the initial explosion?
Graduated scales • interpret unlabelled graduations on a logarithmic scale of any given base, ie interpret fractional powers for a given base	**Graduated scales** • produce a report explaining how and why a slide rule works